Claims

This listing will replace all prior versions, and listings, of claims in the application:

Listing of Claims :

Claim 1 (currently amended): A method for making a thin film device, said method comprising the steps of:

(a) implanting hydrogen ions to a selected depth within a single crystal semiconducting material substrate that can withstand temperatures of 500°C - 1000°C ~~having implant-damaged stiffening material on the single crystal substrate~~ to form a hydrogen ion layer so as to divide the single crystal substrate into two distinct portions;

(b) bonding the single crystal semiconducting material substrate ~~with the stiffening material surface~~ to a flexible substrate, wherein the temperature used for bonding has a maximum temperature of approximately 150°C - 200°C ; and

(c) splitting the single crystal semiconductor substrate along the implanted ion layer, and

(d) removing the portion of the growth substrate, which is on the side of the ion layer away from the flexible substrate, wherein a remaining thin film portion is attached to the flexible substrate.

Claim 2 (currently amended): A method according to claim 1, wherein the single crystal semiconductor substrate further comprises a material selected from a group consisting of silicon, germanium, InP, and GaAs ~~and the stiffening material comprises a material selected from the group consisting of silicon dioxide, silicon nitride, silicon, SiC, diamond, spin on glass, metal, polymer, glass frit, and solder~~ .

Claim 3 (previously amended): A method according to claim 1, wherein the flexible substrate comprises a material selected from a group consisting of stainless steel foil, plastic, polyimide, polyester, and mylar and the stiffening material comprises a material selected from the group consisting of silicon dioxide, silicon nitride, silicon, SiC, diamond, spin on glass, metal, polymer, glass frit, and solder .

Claim 4 (previously amended): A method according to claim 1, further comprising the step of :

depositing a stiffening material layer on the surface of the single crystal substrate devoid of the stiffening material before the implanting step .

Claim 5 (previously amended): A method according to claim 4 further comprising the step of:

directing a high pressure nitrogen gas stream or liquid stream towards the side of the single crystal substrate into which a high dose hydrogen ion implantation has been made to split the single crystal substrate .

Claim 6 (original): A method according to claim 1, further comprising the step of:

implanting boron at the same selected depth as the implanted hydrogen for lowering the thermal energy required to split the growth substrate.

Claim 7 (original): A method according to claim 1, further comprising the step of:

providing an adhesive layer between the bonding surfaces of the thin film functional layer and the flexible substrate before or during step (b) for improving the bonding thereof.

Claim 8 (original): The method according to claim 1, wherein the single crystal semiconductor substrate contain etch stop layers, and wherein the peak of the hydrogen ion implant resides at a depth beyond the etch stop layer.

Claim 9 (canceled)

Claim 10 (original): A method for making a thin film device, said method comprising the steps of:

(a) depositing at least one protective layer on one surface of a large diameter growth substrate;

(b) growing a film layer of thin film functional material on the at least one protective layer, said functional material comprising a material selected from the group consisting of high temperature superconducting (YBCO), ferroelectric, piezoelectric, pyroelectric, high dielectric constant, electro-optic, photoreactive, waveguide, non-linear optical, superconducting, photodetecting, solar cell, wideband gap, shaped memory alloy, and electrically conducting materials;

(c) implanting hydrogen to a selected depth within the growth substrate or within the at least one protective layer to form a hydrogen ion layer so as to divide the material having the growth substrate and the at least one protective layer into distinct portions;

(d) bonding the growth substrate including the at least one protective layer and the thin film layer to a second flexible substrate; and

(e) splitting the material having the growth substrate and the at least one protective layer along the implanted ion layer and removing the portion of the material which is on the side of the ion layer away from the flexible substrate.

Claim 11 (original): A method according to claim 10, wherein the growth substrate is comprised of a material selected from a group consisting of silicon, GaAs, quartz, and sapphire.

Claim 12 (original): A method according to claim 10, wherein the growth substrate comprising silicon.

Claim 13 (original): A method according to claim 10, further comprising the step of:

depositing a stiffening material layer on the surface of the single crystal substrate.

Claim 14 (previously amended): A method according to claim 10, further comprising the step of:

directing a high pressure nitrogen gas stream or liquid stream towards the side of the single crystal substrate into which a high dose hydrogen ion implantation has been made to split the single crystal substrate.

Claim 15 (previously amended): A method according to claim 10, wherein the growth substrate comprising silicon, wherein the at least one protective layer comprising an oxide layer, an adhesion layer, and a barrier layer; and wherein the method further comprising the steps of;

depositing the oxide layer on the silicon substrate;

depositing the adhesion layer on the oxide layer; and

depositing the barrier layer on the adhesion layer for isolating the thin film layer.

Claim 16 (original): A method according to claim 15, wherein the adhesion layer is comprised of titanium, and wherein the barrier layer comprises a material selected from a group consisting of platinum and iridium.

Claim 17 (original): A method according to claim 10, the at least one protective layer comprising MgO.

Claim 18 (original): A method according to claim 10, wherein the thin film functional material is comprised of a material selected from a group consisting of a single crystal material, a polycrystalline material, and a high temperature sinter ceramic material.

Claim 19 (original): A method according to claim 10, wherein the flexible substrate further comprises a material selected from a group consisting of stainless steel foil, plastic, polyinide, polyester, and mylar.

Claim 20 (original): A method according to claim 10, further comprising the step of:

annealing the thin film functional material layer for strengthening and tempering the thin film layer.

Claim 21 (original): A method according to claim 10, further comprising the step of:

implanting boron at the same selected depth as the implanted hydrogen for lowering the thermal energy required to split the growth substrate.

Claim 22 (original): A method according to claim 10, further comprising the step of:

providing an adhesive layer between the bonding surfaces of the thin film functional layer and the flexible substrate before or during step (d) for improving the bonding thereof.

Claim 23 (original): A method for making a thin film device, said method comprising the steps of: (a) growing a film layer of thin film functional material on the surface of a growth substrate, said functional material comprising a material selected from the group consisting of high temperature superconducting (YBCO), ferroelectric, piezoelectric, pyroelectric, high dielectric constant, electro-optic, photoreactive, waveguide, non-linear optical, superconducting, photodetecting, solar cell, wideband gap, shaped memory alloy, and electrically conducting materials;

(b) implanting hydrogen to a selected depth within the growth substrate to form a hydrogen ion layer so as to divide the growth substrate into distinct portions;

(c) bonding the growth substrate and associated material having the thin film layer to a second flexible substrate;

(d) splitting the material having the growth substrate and thin film material along the implanted ion layer and removing the portion of the material which is on the side of the ion layer away from the flexible substrate.

Claim 24 (original): A method according to claim 23, further comprising the step of:

depositing a stiffening material layer on the surface of the single crystal substrate.

Claim 25 (original): A method according to claim 23, further comprising the steps of:

directing a high pressure nitrogen gas steam or liquid stream towards the side of the single crystal substrate into which a high dose hydrogen ion implantation has been made to split the single crystal substrate.